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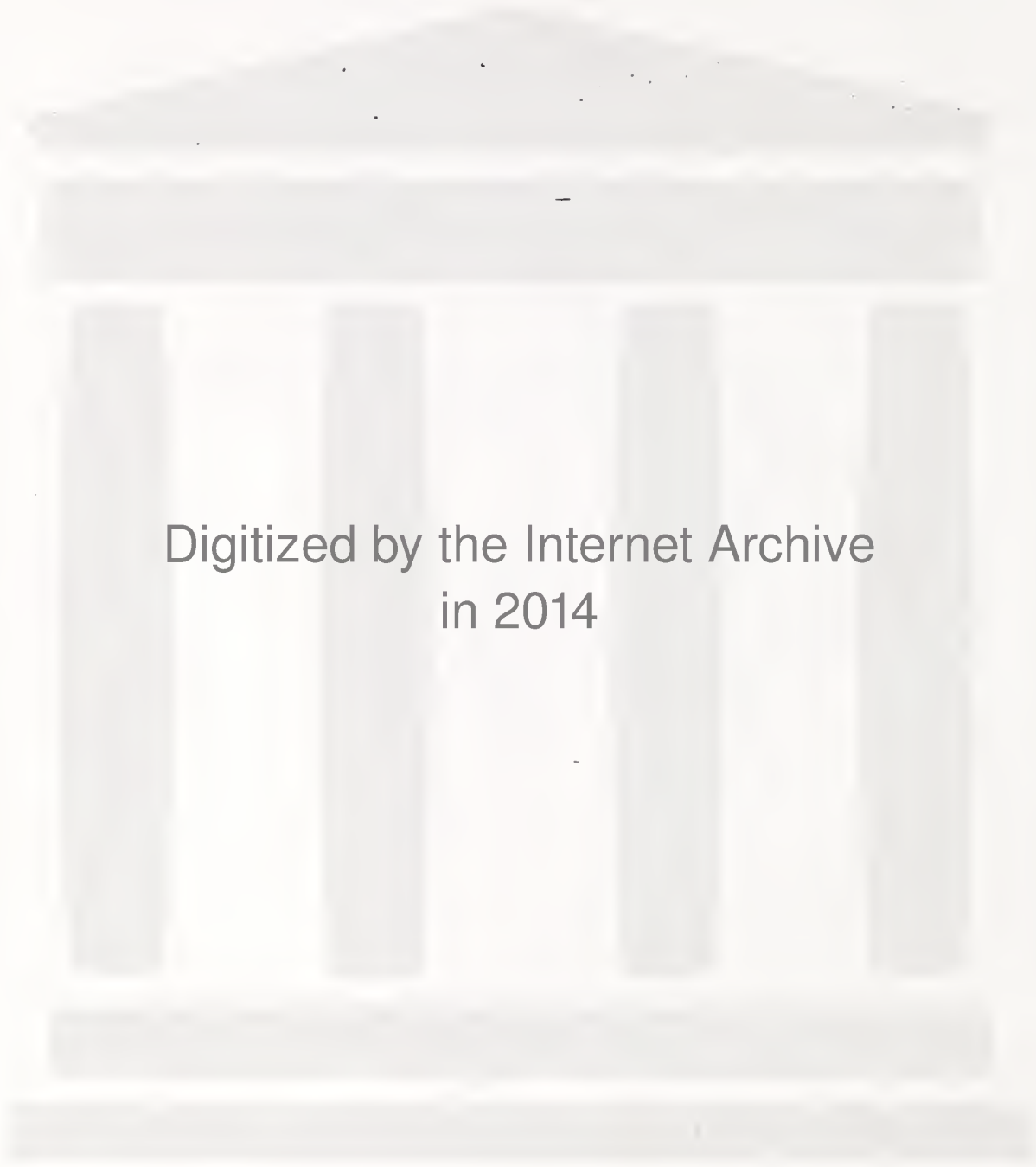
THE WOLVES OF YELLOWSTONE

Natural Resources Report
Number 14

U.S. Department of the Interior
National Park Service



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THE WOLVES OF YELLOWSTONE

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Best Regards,
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ABSTRACT

Historical records and intensive field surveys 1975-77 provided information on the population history, ecology, and current status of wolves (*Canis lupus*) in Yellowstone National Park and vicinity. Wolves occurred in unknown but seemingly low densities during the latter 1800s in several areas of Yellowstone where they were controlled periodically until 1926. Populations apparently began increasing about 1912, primarily in the northeast, and may have reached nonequilibrium levels of 30-40 animals (postwhelping). Intensive control 1914-26 removed at least 136 wolves, including about 80 pups. During this period Yellowstone wolves characteristically lived in packs of 3-16 members, some of which followed the ungulates in their seasonal migrations. Litters averaging 7.8 were born in late March and April, primarily in the north central sector of the park. Limited evidence suggests that elk (*Cervus elaphus*) were important food for wolves during all seasons. Wolves either survived the control era or moved in shortly thereafter for singles, pairs, and a pack of four were reported the following decade. Resident wolf packs, however, were eliminated from Yellowstone National Park by the 1940s. Large canids have been sighted intermittently to the present, but their identity has not been established. Singles and pairs comprised 89% of 116 "probable" reports over the past 50 years. Speculation about factors limiting the Yellowstone wolf population considers its relative geographic isolation from viable wolf populations and possible genetic problems (including wolf-coyote hybridization) associated with prolonged minimal population status. A transplant of wolves from British Columbia or Alberta, or perhaps Minnesota, is recommended to restore a viable population of this native predator to Yellowstone National Park.

Cover drawing by Carol Snow

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

THE WOLVES OF YELLOWSTONE

INTRODUCTION

Wolves historically occupied a wide range of habitats throughout much of North America north of the 20th parallel in southern Mexico (Goldman 1944), but their geographical range in the contiguous United States today has been reduced by nearly 99% (Mech 1971). The Northern Rocky Mountain Wolf (NRMW) (*C. l. irremotus*), one of 23 subspecies recognized by Goldman, once roamed the backbone of the continent from southern Idaho and Wyoming to southeastern British Columbia and southern Alberta (Fig. 1). Wolves throughout this area, including Yellowstone National Park, were reduced drastically by the 1930s by government and private control. In 1973 the Secretary of the Interior placed the NRMW on the Endangered Species List.

The primary purpose of administration of natural areas by the National Park Service is to preserve natural environments and native plant and animal life while providing for enjoyment by visitors in ways which maintain natural conditions (USDI National Park Service 1968). Mission-oriented research involves determining the completeness of park ecosystems and developing management procedures to prevent or compensate for departures caused by human actions (Cole 1969a). Lack of ecological completeness, for example, might stem from unnatural reduction or elimination of predator populations.

In recent years personnel and visitors in Yellowstone National Park have reported sightings of large canids (Cole 1971). No intensive field research, however, had been conducted specifically on wolves there. Mech (1971) stated:

> For the wolves reported from Yellowstone Park, an immediate and concerted program is necessary. Intensive efforts should be made to determine the extent of populations . . . both in terms of numbers and area occupied. Special attention should be given to determine whether breeding and successful reproduction are taking place.

In August 1975, I was contracted as an independent research biologist by the National Park Service to survey the status of wolves in Yellowstone National Park. Objectives of the study were to compile the historical information on wolves in Yellowstone and to determine their present distribution, abundance, and reproductive success.

1. *Canis lupus tundrarum*
2. *C. l. pambasileus*
3. *C. l. alces*
4. *C. l. occidentalis*
5. *C. l. hudsonicus*
6. *C. l. arctos*
7. *C. l. orion*
8. *C. l. labradorius*
9. *C. l. beothucus*
10. *C. l. lycaon*
11. *C. l. nubilus*
12. *C. l. irremotus*
13. *C. l. columbianus*
14. *C. l. ligoni*
15. *C. l. fuscus*
16. *C. l. crassodon*
17. *C. l. youngi*
18. *C. l. mogollonensis*
19. *C. l. monstrabilis*
20. *C. l. baileyi*
21. *C. l. bernardi*
22. *C. l. mackenzii*
23. *C. l. manningi*

FIGURE 1. North American distribution of subspecies of *Canis lupus* (*from* Goldman 1944).

STUDY AREA

A 19,151 km^2 (7,481 mile^2) area, encompassing Yellowstone National Park and a 16-24 km strip around its perimeter in northwestern Wyoming and adjacent parts of Montana and Idaho (Fig. 2), was selected for the wolf survey. Much of the area is designated or *de facto* wilderness, and developments such as roads, buildings, and campgrounds occupy less than 1% of the park.

Quaternary volcanic deposits which have undergone three glaciations cover most of the area (Keefer 1972). Elevations range from about 1,500 m to over 3,400 m, but forested rhyolite plateaus at 2,100-2,600 m are extensive.

Winters are usually long and cold while summers are short and cool (Dirks 1976; Houston 1976). Most of the annual precipitation of 34.5-96.5 cm falls as snow. In general, temperatures are lower and precipitation higher in the central and southern parts of the area.

About 79% of the terrestrial area of Yellowstone is forested, with lodgepole pine (64%) and subalpine fir-Engelmann spruce (6%) predominating. Despain (1973) and Houston (1976) have described the vegetation.

Distribution and estimated abundance of bison (*Bison bison*) (Meagher 1973), elk (Cole 1969b; Craighead et al. 1972; Houston 1974), moose (*Alces alces*), mule deer (*Odocoileus hemionus*), pronghorn antelope (*Antilocapra americana*), and bighorn sheep (*Ovis canadensis*) (Barmore in prep.) have been reported (Table 1). Ecology of the coyote (*Canis latrans*) (Murie 1940) and grizzly bear (*Ursus arctos*) (Craighead et al. 1974; Mealey 1975; Cole 1976; Knight et al. 1977) has been presented. Houston (1973) commented upon the status of mountain lions (*Felis concolor*) and wolverines (*Gulo gulo*) in the park.

METHODS

Information on the history and ecology of wolves in Yellowstone National Park up to the 1930s was obtained from journals, Army scout diaries, Army station records (extracted by M. Meagher), and from monthly and annual reports of the superintendent, in the Yellowstone National Park Research-Reference Library.

Population trends since that time to the present were assessed from nearly 500 reports of wolf-like animals and/or sign. These reports included replies to a questionnaire mailed to 89 big-game outfitters operating on the Gallatin, Shoshone, and Teton National Forests adjacent to the park. A point system was devised for evaluating and categorizing the observations (Table 2). The principal criteria included experience and reliability of the observer, details of the observation, and description of the animal and/or sign which would distinguish it in external appearance from other canids. Reports were categorized as "probable" or "possible," depending upon the number of points received. A "positive" category was reserved for instances where an animal was trapped or killed and verified as a wolf.

This point system was designed to be conservative. For example, an observation of a large gray canid at short range by a person familiar with Western coyotes received a "possible" evaluation. Reports citing a distinctive color, howl, or track rated "probable" if the observer was

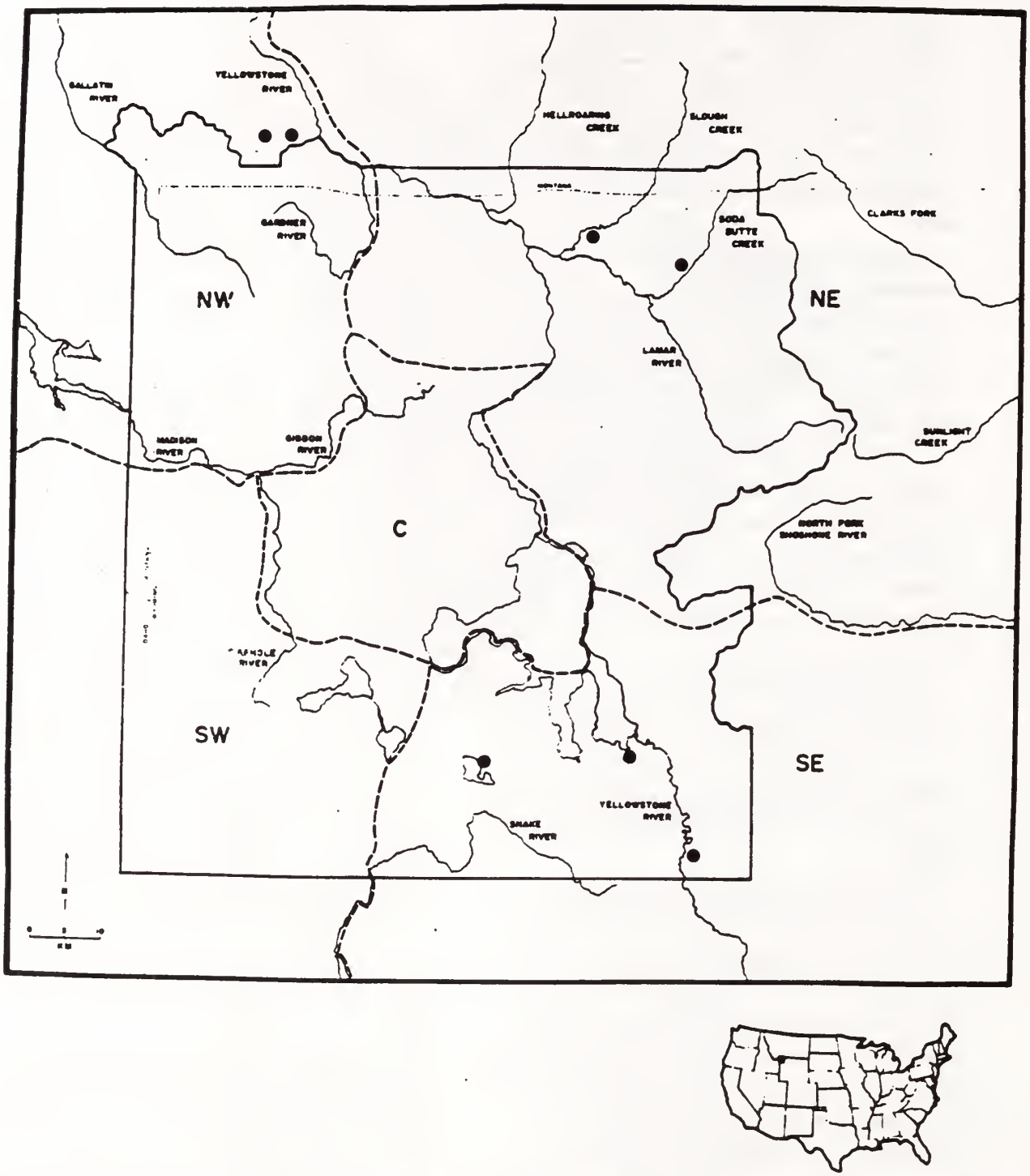

FIGURE 2. Location of the Yellowstone wolf study area. Broken lines arbitrarily distinguish five geographical sections to facilitate discussion of reported wolf observations. Shaded circles represent ungulate baits and/or canid scent and time-lapse cameras, February-March 1977.

TABLE 1. Seasonal population estimates of ungulates in Yellowstone National Park; 1977.

Species	Summer	Winter
Elk	20,000-25,000	10,000-13,000
Mule deer	2,000- 4,000	500- 2,000
Moose	1,500	1,000
Bison	1,100- 1,200	1,100- 1,200
Bighorn sheep	600	600
Pronghorn antelope	150	150

qualified. All reports were classified independently of any others.

This system remains subjective, however, and with such sources, all reports are questionable to a degree. Some observations, especially those from the 1930s and 1940s, may well have been of wolves but were classified "possible" for lack of details. Some "probable" sightings may have been of large coyotes. Nonetheless, the point system provides consistency for evaluating these observations. All reports were coded on computer-compatible sheets and filed at park headquarters.

I spent 12 months in the field, August-October 1975 and August 1976-April 1977, searching intensively for wolves and/or sign. Since the wolves' reproductive success was an important question, I designed the field study to cover periods of breeding, denning, and rendezvous activity. My field assistants and I traveled approximately 2,700 km on foot, skis, and snowshoes while inspecting government-maintained trails, game trails, ridges, and stream courses for wolves, tracks, and scats.

Tape-recorded and human-imitated wolf howls were broadcast approximately 1,400 times both day and night from elevated spots (Joslin 1967). A parabolic microphone was available for recording any responses.

Baits of road-killed ungulates and canid scent were placed at seven locations in and near the park (Fig. 2), February-March 1977, and were monitored with time-lapse movie cameras (Diem et al. 1973). Some cameras were preset to expose a single-frame picture at 1.5-minute intervals; others, at 8-minute intervals.

Thirty hours in flight time were spent searching specifically for wolves and/or sign. In addition, approximately 1,800 hours have been logged by other park research biologists since 1964 during wildlife distribution and censusing flights.

Most of the intensive ground search concentrated on the northeast and southeast portions of the study area (Fig. 2), whereas flights were made over most of the park.

THE YELLOWSTONE WOLF

The wolves of Yellowstone--*C. l. irremotus*--probably intergraded with *columbianus* to the north, *nubilus* to the east, and *youngi* to the south (Goldman 1944). Specimens from northwestern Wyoming were considered by Goldman to be "somewhat

TABLE 2. Criteria and point system for categorizing wolf observations.[a]

Criteria	Points
Observer	
experience with Western coyotes	7
experience with wolves	3
Observation	
distance	
<100 m	3
100-400 m	2
>400 m	1
length of observation time	
>10 seconds	1
optical aid such as binoculars	1
Description of animal and/or sign	
body description	
large body size	4
large and blocky head, short ears, and relatively short muzzle	4
relatively large, long legs	2
color	
solid white or black	10
howl	
distinctively different from coyote	10
track	
>10 cm (4.0 in) long including toenails (must include evidence to rule out domestic dog)	10

[a]Reports scoring ≥16 points qualified as "probable"; those <16 points, "possible." *See* text for discussion of system.

intermediate" between *irremotus* and *youngi*.

Goldman (1944:404) pointed out that gray wolves ". . . are all very similar in the more essential features and are believed to intergrade through the vast range of the species on the North American mainland."

Indeed, taxonomists today, with multivariate statistical techniques, might reduce the number of wolf subspecies or perhaps eliminate them altogether (*see* Nowak 1973; Jolicoeur 1975; Skeel and Carbyn 1977). Although there are reasons to question the

validity of the subspecific groupings, I use Northern Rocky Mountain Wolf (NRMW) for convenient reference to this geographical population. Wolf taxonomy and its implications for management will be discussed later.

The NRMW is medium- to large-sized for the species. An adult male from Red Lodge, Montana, measured 1,870 mm (61.4 inches) total length, while two adult females from Soda Springs, Idaho, measured 1,929 and 2,046 mm (Goldman 1944). An adult male taken in Montana in 1968 weighed 42 kg (92 lb) (Gary Day pers. comm.). For wolves in Yellowstone, Bailey (1930) stated: "The male is consistently larger than the female, weighing well over a hundred pounds."

Goldman (1944) described the winter pelage of the NRMW:

> Upper parts from nape to rump usually near "light buff" or varying shades of gray, sparingly overlaid with black, becoming nearly white on sides and limbs; short pelage on top of head light buffy white, the hairs tipped with black; ears and upper surface of muzzle light buffy; under parts in general more or less soiled white; tail above light buffy, thinly and inconspicuously overlaid with black, light buffy below to tip, which is a mixture of buff and black all around. Individuals in the black phase appear to be rare.

Of 136 wolves killed in the park, three were black and one was white (Fig. 5); two others observed were black. All others were gray. It seems reasonable that most black or white wolves, due to their conspicuousness, would be reported. Neither the reported kills nor the recorded observations substantiate Skinner's (1927) claim that up to 40% of Yellowstone wolves were black.

POPULATION HISTORY

Prior to 1914

Wolves were members of Yellowstone's native fauna. Although few observations were recorded during the 1800s (Appendix I), this could reflect either an actual low density of wolves or simply a lack of records. Some early writers used "wolf" in reference to both true wolves and coyotes ("small prairie wolf" or "medicine wolf") (*see* Haines 1955:129), but reports from about 1880 on usually distinguished the two species. Five accounts of gray wolves were recorded 1869-80.

At least as early as 1877, however, ungulate carcasses in the park were poisoned with strychnine by free-lance "wolfers" for "wolf or wolverine bait" (Supt. Annual Rept. 1877). By 1880, Superintendent Norris stated in his annual report that ". . . the value of their [wolves and coyotes] hides and their easy slaughter with strychnine-poisoned carcasses have nearly led to their extermination." Sightings of single wolves, pairs, and groups of three and six were recorded 1881-1908, primarily in the Geyser Basins (C), Hayden Valley (C), and Lamar (NE) (Fig. 4).

The Yellowstone wolf population apparently began to increase about 1912, at least in the northern sector. In a letter dated 29 July, 1912, Col. L. M. Brett remarked that ". . . several were killed on the Upper Gallatin River but a few miles outside [the park] . . . last spring" (Appendix I). Skinner (1927) observed four wolves in Lamar Valley that same year and

FIGURE 3. Three wolves killed near Hellroaring Creek (NE) and the den in a rock cave from which six pups were removed, Yellowstone National Park, April 1916 (*from* Bailey 1916).

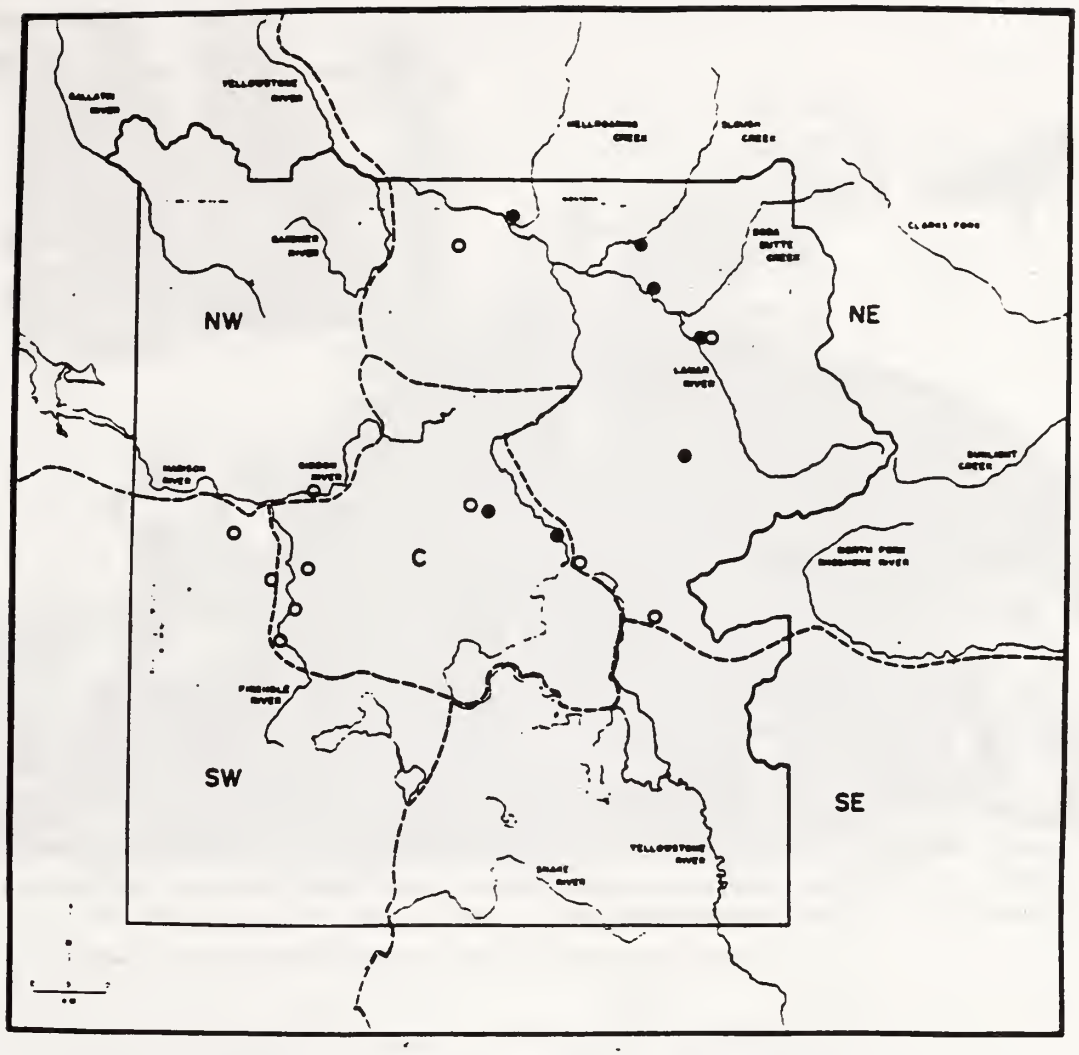

FIGURE 4. Location of wolf observations in Yellowstone National Park prior to 1914. Open circles represent sightings of singles or pairs; shaded circles, three or more animals together.

believed wolves "were coming in faster." Randall (1966) saw a pack of nine along the Yellowstone River near Hellroaring in spring, 1913.

1914-1926

By 1914, wolves had increased noticeably in northeast Yellowstone Park (Supt. Annual Rept. 1914). They were considered, though, "a decided menace to the herds of elk, deer, mountain sheep, and antelope" (Supt. Annual Rept. 1915) and concerted efforts to "exterminate" (Supt. Monthly Rept. February 1919) wolves were mounted. Opposition to this policy was ignored as suggested by the following (Supt. Monthly Rept. May 1922): "It is evident that the work of controlling these animals must be vigorously prosecuted by the most effective means available whether or not this meets with the approval of certain game conservationists."

During 1914-26 a minimum of 136 wolves--including about 80 pups (59%)--were removed from dens, trapped, shot, and probably poisoned within the park (Table 3). This total is slightly higher than Skinner's (1927) and Murie's (1940) due to a more detailed examination of historical sources. In each of 3 years (1918, 1920, 1922), the toll exceeded 24 animals (mostly pups). In

FIGURE 5. Wolf pups trapped at bison carcass near Soda Butte (NE), Yellowstone Park, October 1926. (*Photo by* Scott Riley.)

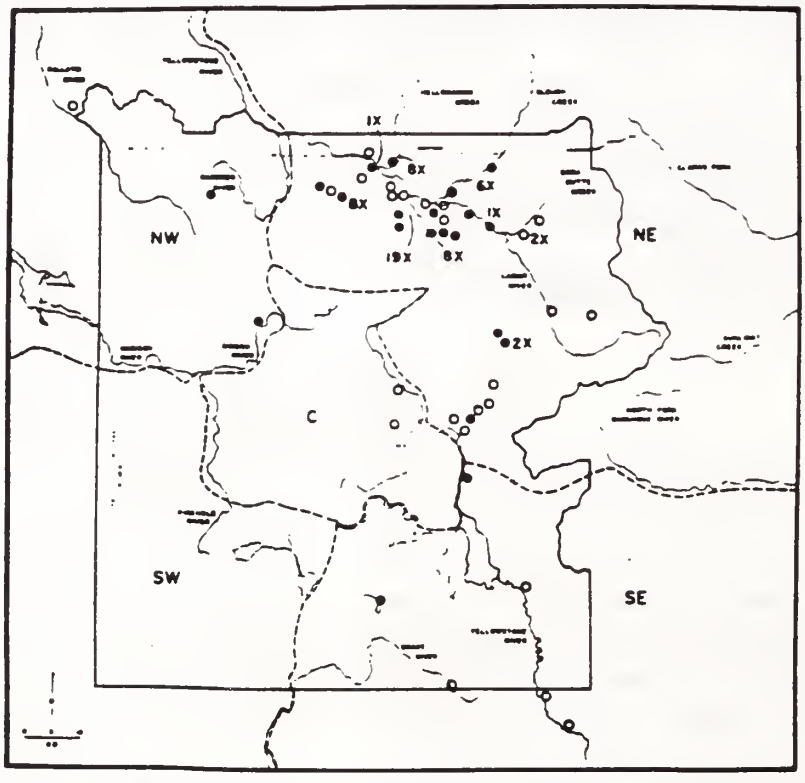

FIGURE 6. Location of observations and numbers of wolves killed (X) in Yellowstone Park and vicinity, 1914-26. Open circles represent sightings of singles or pairs; shaded circles, three or more animals together.

TABLE 3. Wolf mortality in Yellowstone National Park, 191--26.

Year	Adults	Pups	Totals[c]	
			Monthly Repts.	Annual Rept.
1914	7	-	7	-
1915	3	4	7	"several"
1916	2	8	10	12
1917	2	-	2	-
1918	21	14[a]	35	36
1919	2	-	2	6
1920	6	20+[b]	26+	38
1921	3	11	14	
1922	9	16	25	24[c]
1923	1	5	6	8
1924	-	-	-	-
1925	-	-	-	-
1926	-	2	2	-
Total	56	80	136	114

[a] Report did not distinguish between adults and pups. Nineteen wolves were killed in April and I have assumed that, as for the same month in other years, most of these were pups.

[b] One den with unreported number of pups was closed up.

[c] Combined for 1921 and 1922.

[d] Monthly reports were more detailed and were considered to be the best source.

1918, 21 adult wolves were killed. The annual kill fluctuated throughout this period, indicating either real changes in wolf numbers or varying effort by the control personnel, or both. Certain trends, however, appear evident.

Between 1914 and 1923, 15 (56%) of 27 reports involved three or more wolves together (Appendix II). Four occupied and distinct dens found in 1916 and 1920 suggest at least four different reproductive units those years. The last den destroyed by park personnel was in 1923 near Tower Falls (NE). In the next 3 years, only 3 (21%) of 14 reports mentioned more than two wolves together. Two pups were trapped near Soda Butte (NE) in October 1926 (Fig. 5).

All the reported killing of wolves occurred in the northeast section from near Mammoth east to Soda Butte and south to Pelican Valley (Fig. 6), as did many observations. In addition, one or two wolves were sighted occasionally in the southeast section. Hayden Valley and the Geyser Basins, areas occupied by wolves around the turn of the century, furnished but one record of a single animal during 1914-26.

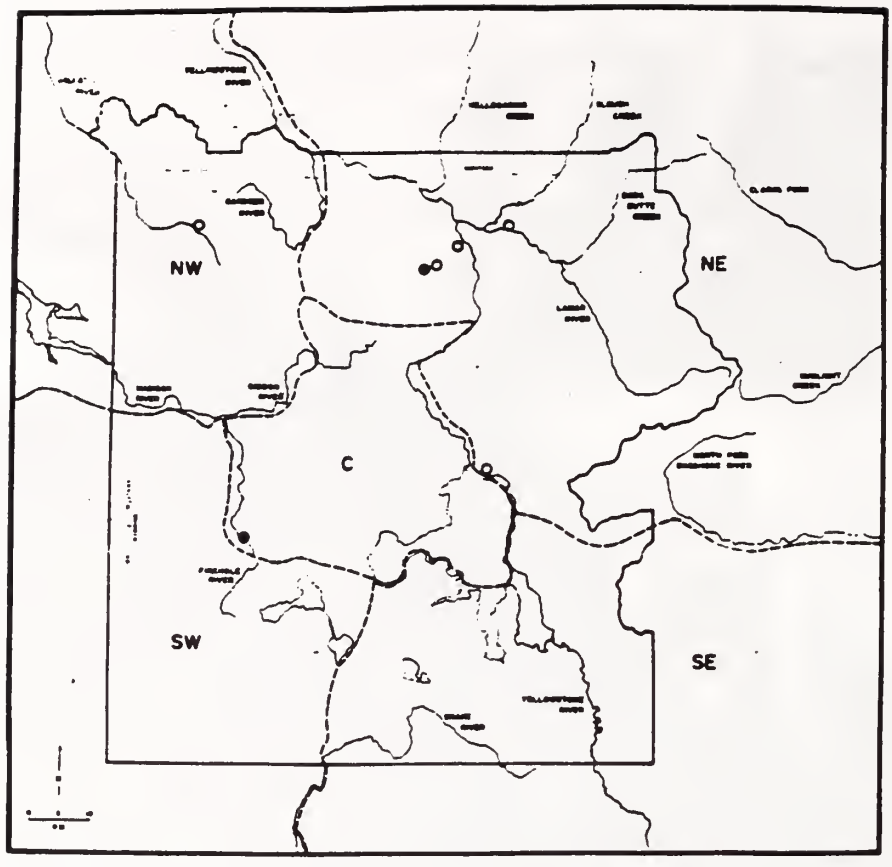

FIGURE 7a. Locations of canid observations in Yellowstone Park and vicinity, 1927-36. Open circles represent sightings of singles or pairs; shaded circles, three or more animals together.

1927-1966

The population history of wolf-like canids in Yellowstone 1927-66 relies upon reports which have been classified "probable" and Superintendent Monthly Reports up to 1936. Within the recognized subjective nature of the data, this represents my best interpretation of wolf population trends during those years. To facilitate discussion, I grouped reports into 10-year periods.

1927-36. In the decade following intense persecution of wolves in the park, 14 observations of 29 large canids were tallied. Seven reports involving 17 animals were classified "probable" (Fig. 7a) (*see* Appendix III). A pack of four was observed up Tower Creek (NE) in 1934 (Arnold 1937), but sightings of singles or pairs accounted for five of seven reports.

1937-46. There were 16 reports of 18 large canids for this period; 8 of these involving 10 animals were rated "probable" (Fig. 7b). Three wolves were seen in 1937 on lower Specimen Ridge, a single on Soda Butte Creek in 1938, and another single just north of the park in 1942 (all in NE). A wolf was observed up Mol Heron Creek (NW) in 1942 and another up the Gallatin River the following year. In 1944, single wolves were reported at Heart Lake (SE), Elk Park (NW), and Crevice (NE). Sightings of singles or pairs comprised seven of eight reports.

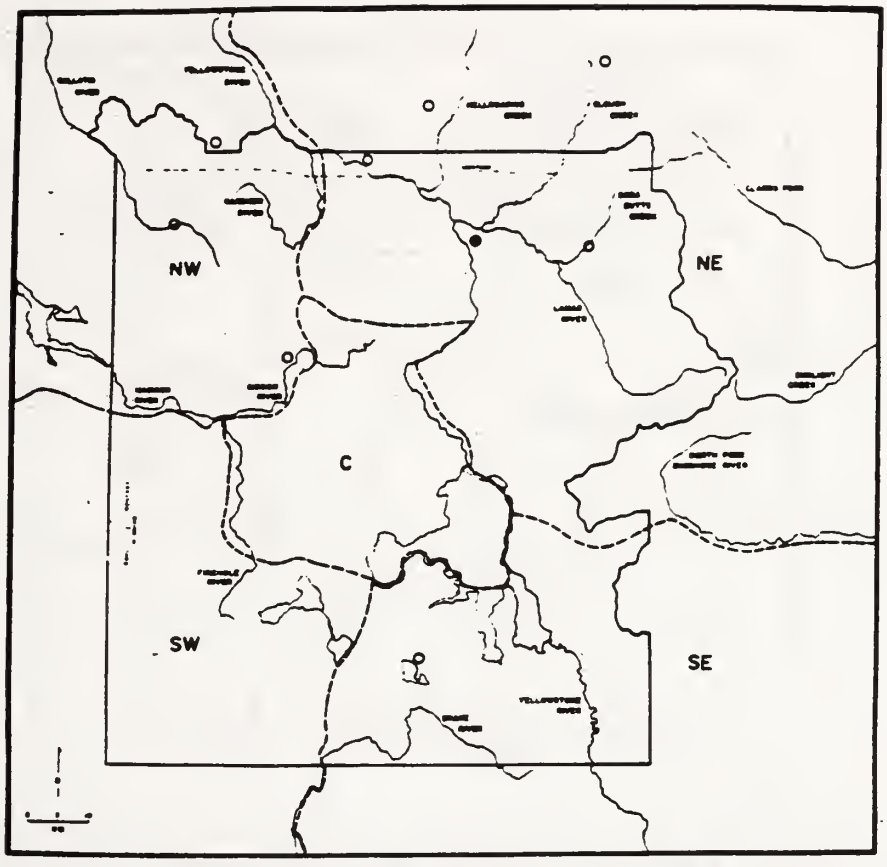

FIGURE 7b. Locations of canid observations in Yellowstone Park and vicinity, 1937-46. Open circles represent sightings of singles or pairs; shaded circles, three or more animals together.

1947-56. Twenty-six reports of 37 canids were received; six involving 10 animals were classified "probable" (Fig. 7c). Two wolves were observed at Soda Butte in 1947, one near Lost Creek in 1949, and three at Amethyst Creek in 1952 (all in NE). A single, large canid was seen just south of the park in 1950. Along the Madison River, a pair of wolves was seen in 1952 and a single, the following year. Five of these six "probable" reports mentioned only singles or pairs.

1957-66. Thirty-two observations of 42 canids were recorded. Fourteen reports involving 21 animals received a "probable" rating (Fig. 7d). Single wolves were observed in the northeast in 1957, 1958, 1963, and 1965. A large adult canid with three pups was reported there in 1963. Singles were seen near Swan Lake (NW) in 1958 and 1965 and a pack of three on the Gallatin River in 1966. One of two wolves observed up Mol Heron in 1963 was shot but not recovered. In 1960 one wolf was reported at Grouse Creek (SE) south of Yellowstone Lake and another, along the east boundary near Sunlight Basin (NE). A single wolf was seen near Porcupine Hills (C) in 1963. Sightings of singles and pairs constituted 12 of 14 reports.

Summary. Wolf-like canids either survived the 1914-26 control era in Yellowstone National Park or moved in shortly thereafter. Murie (1940) believed that "the last wolves were eliminated in the twenties although a few have been reported in recent

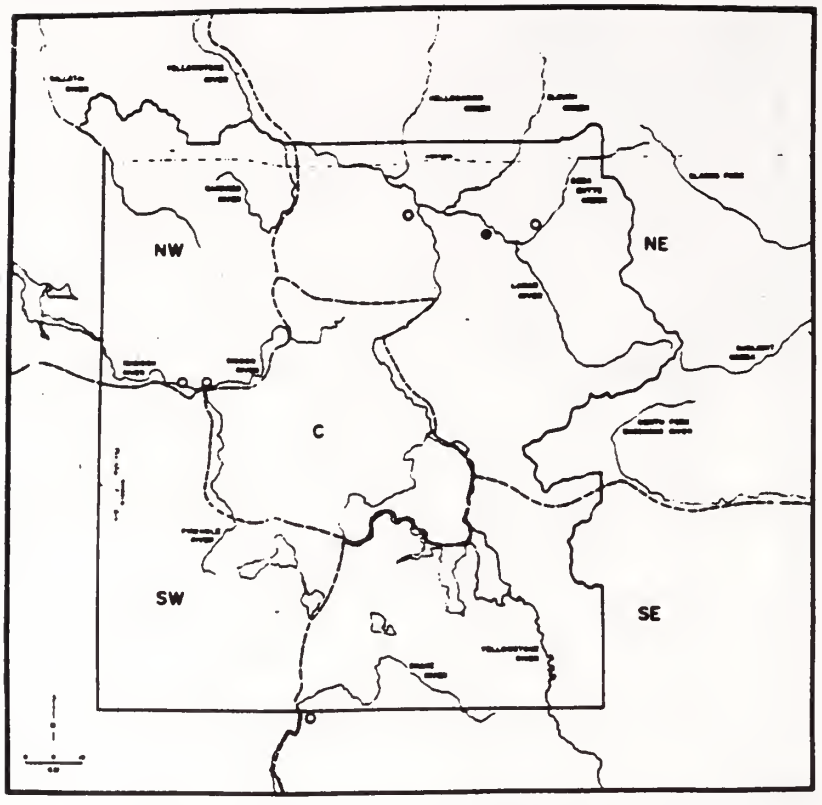

FIGURE 7c. Locations of canid observations in Yellowstone Park and vicinity, 1947-56. Open circles represent sightings of singles or pairs; shaded circles, three or more animals together.

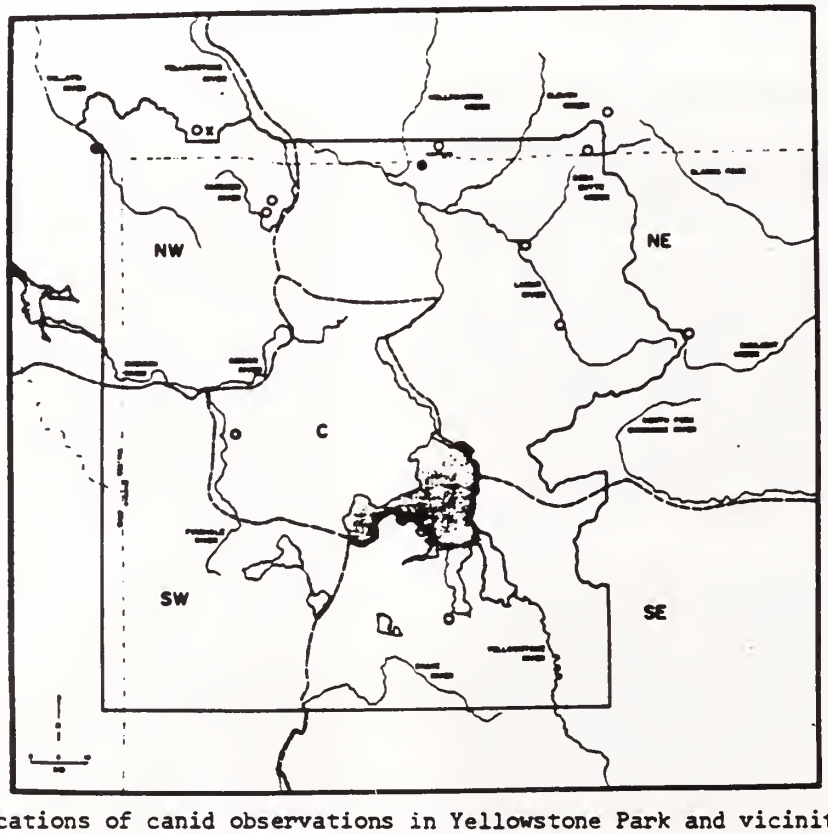

FIGURE 7d. Locations of canid observations in Yellowstone Park and vicinity, 1957-66. Open circles represent sightings of singles or pairs; shaded circles, three or more animals together.

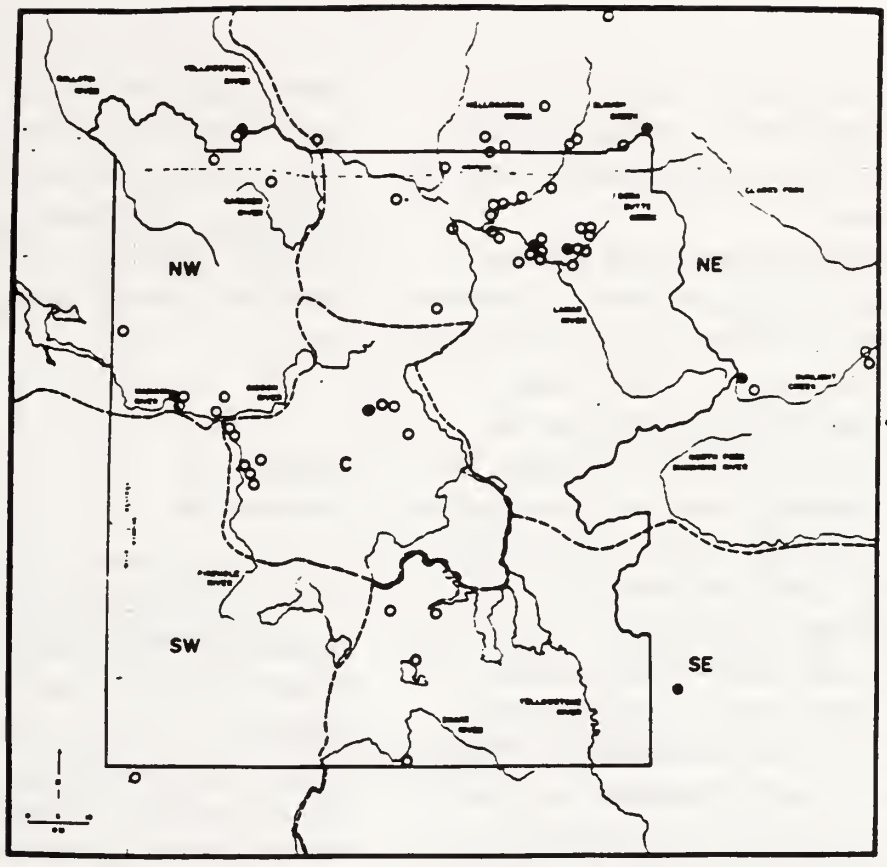

FIGURE 8. Locations of canid observations in Yellowstone Park and vicinity, 1967-April 1977. Open circles represent sightings of singles or pairs; shaded circles, three or more animals together.

years." Two packs of three to four and five wolves may still have been present in the mid-1930s, but records do not indicate they persisted. During the next 30 years, observations of wolf-like canids--mostly singles and pairs--were reported sporadically from the northwest and northeast sections of the study area.

POPULATION STATUS

1967-April 1977

During the past decade, 401 reports of 531 canids have been received; 81 involving 109 animals were classified "probable" (Fig. 8). The increase in reports during this period was due partly to a system established in 1968 for recording sightings of wolves (Cole 1971) and to greater awareness of their possible occurrence in the park.

About 90% of the "probable" observations came from four areas (Fig. 8). Each year throughout this period, one or two wolf-like canids have been seen in the northeast. In Hayden Valley (C), a single wolf was observed in 1969 and 1971. A wolf reportedly was shot in Sunlight Basin east of the park in January 1968, but no remains were found the following summer. Sightings of a large canid in that area were recorded in 1968, 1969, 1971, and 1975. In the northwest section of Yellowstone, one to five wolves were seen in 1968-70, a pair in 1971, and singles in 1972 and 1974. None has been reported from that area since. Sixty

(74%) of the "probable" observations occurred during 1968-71. Singles and pairs accounted for 91% of these reports over the entire period.

During approximately 1,800 hours of flight by park biologists over all sections of the park since 1964, only one wolf-like canid has been seen. D. Houston and D. Stradley observed this dark animal in Hayden Valley in 1971, but poor light conditions precluded a positive identification.

During 12 months I found only two separate sets of tracks and heard one series of howls which may have been wolf. All occurred on the Shoshone National Forest, Wyoming, within 20 km of each other and 1-22 km east of the park boundary. Tracks measuring 11.3 cm (4.5 inches) long (including nails) by 9.6 cm (3.8 inches) wide with a 63-cm stride were found in sand near a stream on 7 September 1975. No evidence of human activity or domestic dogs was discovered anywhere in the general area. Tape-recorded wolf howls were broadcast the previous and following nights, but no responses were heard. Two weeks later, one canid howled three separate times in response to a broadcast wolf howl. This occurred about 18 km from the site of the tracks. The animal was in dense timber and never was observed. No measurable tracks were found as the ground was hard and dry. The howls were not recorded, but I am confident the animal was not a coyote. Subsequently, 34 days were spent afield in this area (August-September 1976, April 1977). Canid tracks, identical in measurement to the first set, were found 20 April 1977 about 2 km from the site of the howls. Casts of these tracks are in the park Museum Collection.

No wolves were photographed by time-lapse cameras monitoring the ungulate baits and/or canid scent during February-March 1977, nor were any observed during 30 hours of flight. Unfortunately, winter conditions were very mild and many wildlife species remained scattered throughout the study area.

ECOLOGY

Reproduction

Breeding and Denning Dates. The earliest positive birth date known for wolves in Yellowstone was 26 March (1916) when pups, judged less than 1 week old, were taken (Appendix II). Pups were removed from dens in March 1920 and 1921, but the exact date was not recorded. Skinner (1927) reported "three lots of pups which were born about March 1." Pups of unreported age were taken from other dens 1-8, 16, and 30 April, and 12 May. For wolves in the Bighorn Basin of north-central Wyoming, King (1965) related denning dates of 25 and 29 March and 19 April. Assuming a 63-day gestation (Brown 1936; Woolpy 1968), these dates indicate that Yellowstone wolves bred anytime from January until early March. This breeding season coincides with others reported from a similar latitude (Mech 1970:117).

Litter Sizes. The size of 10 presumably complete wolf litters extracted from dens averaged 7.8 and ranged from 5 to 13 (Fig. 9). Litters of 11 and 10 were found in 1921 and 1922, respectively, following several years of persecution. Such large litters seem characteristic of exploited wolf populations (Mech 1970).

Dens. Bailey (1930) stated that wolf dens in Yellowstone were usually "situated in caves or hollows among rocks or sometimes,

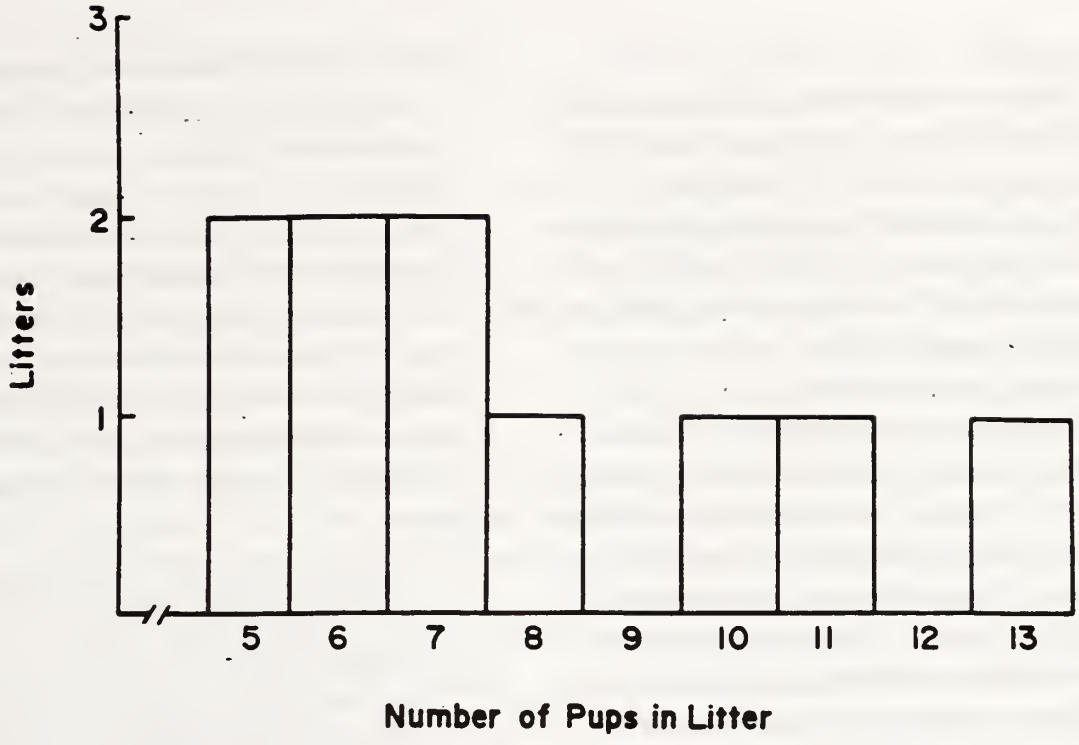

FIGURE 9. Histogram of litter sizes of wolves in Yellowstone Park, 1916-23.

in large burrows on steep hillsides." He described a den near Hellroaring as composed of four or five large burrows dug into the open hillside "which, evidently, had been used for several years." When disturbed by humans, the adults moved the pups to another den in a natural cave about a mile (1.6 km) away (*see* Fig. 3).

Certain physiographic features appear characteristic of these and other wolf den sites described in the literature (Mech 1970:120-121; Stephenson 1974). Typically, dens are located on south or southwest aspects of moderately steep slopes in well-drained soils (or rock caves), at elevations 2-200 m above the surrounding area, and usually within 30-200 m of surface water. All the reported wolf dens in Yellowstone were located in the north central part of the park, from Blacktail Deer Plateau to Specimen Ridge (Fig. 10).

Rendezvous Sites. Murie (1944) used the term "rendezvous" for specific resting and gathering areas occupied by wolf packs during summer after the natal den has been abandoned. These are usually small, open meadows close to wooded cover and surface water (Joslin 1967; Carbyn 1974). In August 1922, Park Ranger Anderson found an apparent rendezvous site of wolves in Yellowstone.

> This is a section of the park that is practically inaccessible due to bog holes, rim rock, down timber, and jack pines [sic]. The area is the part of the Mirror Plateau lying near the head of Timothy, Raven, Pelican, and Broad Creeks [Appendix II].

It is possible that this area had been used by wolves for rendezvous in previous years. Nowlin (1912) reported wolves howling at the head of Raven Creek on 25 July 1912. Bailey (1930) found tracks "especially numerous along Pelican and Raven Creeks where at least ten or a dozen wolves hunted in one pack in July and August, 1915."

Pack Size

Wolves characteristically live in packs of three or more individuals (Mech 1970). Although a pack usually functions as an intact unit, members may split off temporarily at any season of the year (Murie 1944; Burkholder 1959; Jordan et al. 1967). Hence, cursory observations of wolves may underestimate true pack size.

Nonetheless, even rough estimates of pack size may provide insight if, as Rausch (1967) proposed, pack size reflects population density. Between 1902 and 1926, wolf packs of 3-16 members were reported for 9 different years. Based upon the number of distinct dens occupied by wolves, three to four reproductive units were present in some years (1916-22) in the northeast. By contrast, between 1927 and 1977, there have been "probable" reports of three to five wolf-like canids together in only 8 years. It is doubtful if more than one group existed in any one year.

Seasonal Distribution and Movements

Some wolves in Yellowstone apparently followed the ungulates in their altitudinal migrations to and from summer and winter ranges. Bailey (1930) reported that "during the summers of 1914 and 1915 they [wolves] . . . were following the elk herds to the high pastures of Mirror Plateau, returning with them in winter to the valleys along the Lamar and Yellowstone Rivers." The Superintendent's Monthly Reports during 1918 state:

> Towards the end of the month [May] the wolves seemed to leave the Specimen Ridge district and have not been much in evidence since. They were considerably in evidence in Slough and Hellroaring Creeks [November].

Although some wolves wintering in the Lamar and Yellowstone valleys moved toward Mirror Plateau and Pelican Valley during summer,

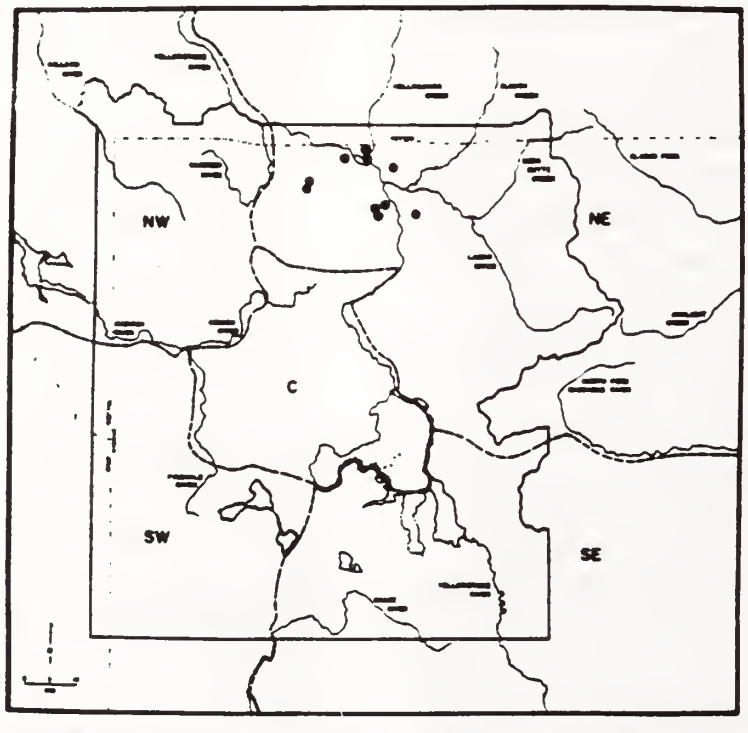

FIGURE 10. Approximate location of wolf dens in Yellowstone Park, 1916-23.

others may have headed north out of the park.

Food Habits

Kills by wolves and scat contents suggest that elk were important prey both winter and summer for wolves in Yellowstone. Scout McBride found a cow elk killed on 21 December 1914, between Mammoth and Blacktail Deer Creek. Between 16 October and 31 January 1916, Scout Black discovered eight elk killed by wolves (Appendix II). Skinner (1927) wrote that during the winter of 1914-15, two or three wolf packs "harried" the elk on the lower valleys of the park. Bailey (1930) reported that wolf droppings in Pelican Valley collected during July 1915 were made up entirely of elk hair. That same month he also discovered a young elk in Slough Creek which he believed had been killed by wolves.

Studies of food habits of wolves in the Rockey Mountain National Parks of Canada (Cowan 1947; Carbyn 1974) and in Glacier National Park in Montana (Singer 1975) provide an interesting comparison with Yellowstone since similar species of prey inhabit these areas. Cowan (1947) reported that elk hair occurred in 49% of winter scats and 42% of summer ones. Mule deer hair was found in about 15% of scats collected at both seasons. Most wolf kills found by personnel were either elk (54%) or mule deer (23%). Cowan believed the actual kill of elk may have been higher because very few scats were collected in areas where wolves subsisted "almost exclusively on elk." Carbyn (1974) found elk hair in 46% of 1,190 summer scats and 11% of 265 winter scats. Mule deer hair was detected more often (66%) in the winter samples than in the summer (30%). His study area contained more mule deer than other areas of Jasper Park where Cowan (1947) worked. In both Canadian studies, bighorn sheep and mountain goats (*Oreamnos americanus*) were comparatively invulnerable to wolf predation. In Montana's Glacier Park, Singer (1975) reported eight white-tailed deer (*Odocoileus virginianus*), three moose, one elk, one beaver (*Castor canadensis*), and five snowshoe hares (*Lepus americanus*) killed by wolves.

Elk were also important food for Yellowstone wolves during the denning season in late March and April. On 26 March 1916, scouts Black and Stevenson found "a score or more of old elk skulls . . . and one fresh elk head" near a den in Hellroaring. A freshly killed young elk was discovered about 0.5 km from another den in the same area. Scraps of elk meat were in the den with the pups (Appendix II). Considering the abundance of beaver between Hellroaring and Tower Falls around 1920 (Warren 1926) and the reported predilection of wolves for them (Voight et al. 1976), it seems likely they formed a portion of the wolves' diet, too. At two wolf dens in Jasper Park, Cowan (1947) found remains of 12 elk, 2 mule deer, and 2 beaver. Carbyn (1974) reported occurrence of mule deer in 44% and elk in 32% of 312 scats collected at wolf dens. Later in summer at rendezvous sites, 55% of 270 scats contained elk, while 22% had mule deer.

Data on the sex and age of ungulates killed by wolves in the Rockey Mountains are limited but suggest that calves or fawns and individuals 10 years and older may be most vulnerable. Of nine elk killed in Yellowstone and reported by scouts, six were adult cows, two were

calves, and one was unidentified. No kills of adult bulls were recorded (Appendix II). In Jasper, Cowan (1947) classified 66 wolf-killed elk: very young--20, mature--29, and diseased-senile--17. Carbyn (1974) believed that young individuals less than 3 years old of all ungulates were most vulnerable to wolf predation. Individuals 3-9 years old appeared relatively secure.

DISCUSSION

Wolves inhabited the Yellowstone area in unknown densities when the park was established in 1872 but were subject to early exploitation (1870s) and later control (1914-26). A noticeable population increase about 1912 was met by intense year-round control, especially removal of pups from dens. Estimates of wolf numbers, based upon population stability via reproductive responses to removal of wolves 5 months and older (Rausch 1967; Kelsall 1968; *see* Mech 1970), cannot be made from the Yellowstone data. Nonetheless, certain comments seem appropriate. Control records (Table 3) and the presence of up to four reproductive units (Appendix II) suggest postwhelping populations of 30-40 wolves around 1920, primarily in the northeast and southeast (Fig. 6). Of 103 wolves observed 1914-23, 83% were in packs of 3 or more. What level the Yellowstone wolf population might have reached had control been minimal remains unknown.

After wolf control ceased within the park in 1926, very few wolves were reported. Whether these were remnant survivors or immigrants, or both, is unknown. Wolf numbers elsewhere in Wyoming and Montana were reduced drastically by this time, too. In Wyoming and South Dakota 508 wolves were killed 1918-23 by government personnel, with the last one taken in 1940 (G. Rost pers. comm.). In Montana, government agents removed 413 wolves during 1918-30 and their last one in 1945 (N. Miner pers. comm.). Yellowstone records do not indicate that any resident wolf packs persisted after the mid-1930s.

Wolf-like canids have been sighted within the study area intermittently to the present, with an increase of "probable" reports 1968-71. Based upon geographical distribution of the sightings and some pelage differences, up to 10 of these canids may have occupied several separate areas around 1970. Observations reflect human distribution and variations in the visibility of animals as well as their actual seasonal ranges. Hence, it is difficult from these cursory reports to determine whether these canids were residents or transients.

The identity of wolf-like canids reported recently in Yellowstone Park has not been established and would require skeletal material. Interpretations include: (1) a remnant population of genetically pure wolves persisted through occasional, successful recruitment; (2) wolves in Canada and Montana immigrated periodically down to Yellowstone; (3) wolves were released into the park; and (4) wolf-like canids occurred through hybridization of various kinds.

The interpretation that a small population of pure wolves survived seems untenable without more consistent evidence of pack activity during the intervening years.

Use of toxicants on surrounding public and private lands would have made journeys hazardous for immigrating wolves. In Glacier National Park, black wolves, more

prevalent in *C. l. "columbianus"* (Canadian) than in *"irremotus,"* comprised 32% of the wolf observations (Singer 1975). Near Three Forks, Montana (100 km northwest of Yellowstone Park), a wolf with a very large skull was killed in 1941, and both Goldman (1944) and Cowan (1947) believed it a Canadian emigrant. But in Yellowstone from 1966-77, 5% of canids sighted were black, suggesting that few Canadian wolves immigrated as far south as Yellowstone.

Despite suggestions of *sub rosa* releases of wolves (Mech and Rausch 1975), park officials have denied that any were ever transplanted to Yellowstone. Although I found no evidence to the contrary, this allegation has not been fully investigated. The possibility of a surreptitious release of captive wolves by private individuals cannot be totally discounted, but their chances for survival would seem slight.

The prolonged geographical isolation of Yellowstone from wolf population centers suggests the remaining possibility--hybridization. While reproductive isolation between species is usually maintained by geographic and ethological barriers, individuals on the periphery of their species' range may have trouble finding a conspecific mate. In the absence of adequate breeding stimuli, they may respond to inadequate signals and hybridize (Mayr 1963). Recent evidence from several areas of North America suggests that coyotes may hybridize both with gray wolves (Kolenosky 1971; Mengel 1971; Kolenosky and Standfield 1975; Lawrence and Bossert 1975; Hilton 1976) and red wolves (*Canis rufus*) (Paradiso and Nowak 1971; Riley and McBride 1972; Gipson et al. 1974; Elder and Hayden 1977). Coyote-dog crosses are considered much less likely in Yellowstone due to its remoteness and the peculiar reproductive timing of such hybrids (Mengel 1971).

Kolenosky (1971, 1977 pers. comm.) reported that F^1 offspring of an Ontario wolf (♀) and coyote (♂) phenotypically resemble Eastern coyotes but with massive legs and large feet. He suspected that if they were sighted in the wild they would be identified as "normal" Eastern coyotes. However, in external appearance, one of the F^2's is almost identical to an Algonquin-type wolf (*see* Kolenosky and Standfield 1975), with larger head, legs, and feet than other progeny. Some wild canids in Ontario (Kolenosky and Standfield 1975) and Maine (Hilton 1977) appear to be mainly coyotes with some introgression of wolf genes. In Yellowstone we have no cranial material with which to trace such an incursion, if it ever occurred. Yet many reports describe animals phenotypically similar to the F^1 canids observed by Kolenosky. Some of the recorded track measurements (9-11 cm long x 7-9 cm wide) are between typical coyote and wolf in size.

Whatever the identity of some large canids in Yellowstone, the sporadic nature of reports and the high incidence (89% of 116 "probable" sightings) of singles and pairs over the past 50 years do not indicate a viable wolf population in the park.

MANAGEMENT RECOMMENDATIONS

A stated purpose of the National Park Service is to "conserve, perpetuate, and portray as a composite whole the indigenous . . . terrestrial fauna" (USDI National Park Service 1968). A departure from natural conditions exists in Yellowstone National Park because fewer pure

wolves, if any, occur now than in the past. Control by humans--both within and outside the park--has brought the Yellowstone wolf to the edge of extinction.

Two options are available for wolf management in Yellowstone National Park: (1) do nothing; or (2) attempt to restore a viable wolf population by introduction. The former alternative has been employed since 1927 when wolf control ceased in the park. Over the next 50 years, a viable population has not reestablished, and the wolf niche appears essentially vacant. Therefore, I recommend restoring this native predator by introducing wolves to Yellowstone.

In proposing a transplant, one must consider the suitability of source stock. The Department of the Interior originally placed *C. l. irremotus* on the Endangered Species List. However, use of trinomens has been questioned for many animals (Wilson and Brown 1953; Brown and Wilson 1954; Hagmeier 1958; Chapman and Morgan 1973), including wolves (Mech 1974; R. M. Nowak pers. com.). Recent multivariate analyses of wolf skulls (Nowak 1973; Jolicoeur 1975; Skeel and Carbyn 1977) have shown few statistically significant differences between many subspecific groupings made by Goldman (1944). Upon consideration of such factors, the U.S. Fish and Wildlife Service has proposed (Federal Register, 9 June 1977:29527) deleting *C. l. irremotus* and listing the entire species (*Canis lupus*) as endangered throughout the 48 contiguous states (except Minnesota).

Perhaps a more important aspect of reintroduction is finding wolves that would have the best chance of adapting to the physiography and prey of Yellowstone. Wolves from the mountains of British Columbia or Alberta would seem suitable, especially if gene flow from that direction has occurred. Wolves from Minnesota are another possible source.

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APPENDIX I

Summary of Wolf Reports Prior to 1914, Yellowstone National Park.

Source	Date	Report
Haines (1955)	1836	Trapper Osborn Russell heard a howl near the outlet of Yellowstone Lake (could be either wolf or coyote.
Haines (1965)	1869 16 September	Howl heard at Cache Creek.
Henderson (1870)	1870	Group (wolves) seen at junction of Cache Creek with Lamar River.
Jones (1875)	1873 6 August	*Doleful howl of a large wolf--* near Pelican Meadows.
Supt. Annual Report (1877)	1877	Ungulate carcasses poisoned with strychnine for wolves.
Supt. Annual Report (1880)	1880	Hides of wolves taken in late fall. *The large ferocious gray or buffalo wolf, the sneaking, snarling coyote, and a species apparently between the two of a dark-brown or black color, were once exceedingly numerous in all portions of the Park, but the value of their hides and their easy slaughter with strychnine-poisoned carcasses of animals have nearly led to their extermination.*
Supt. Annual Report (1881)	1881	Howl heard in Hayden Valley
Hague (1893)	1886-87	Wolf in Upper Geyser Basin.
Hough (1894)	1894 March	Billy Hofex saw wolves in Hayden Valley.
Soda Butte Station Record	1899 1 June	Wolf seen near Slough Creek.
	3 June	Wolf seen near Slough Creek.
	13 June	One wolf seen on northeast side of Slough Creek just above Buffalo Creek.
	29 June	Three wolves seen on southwest side Slough Creek.
Fountain Station Record	1901 13 November	Wolf tracks seen at Lower Geyser Basin.
	19 November	Wolf tracks seen at Bear Park.
Lake Station Record	1902 20 September	Six wolves seen between Lake and Mud Geyser.
Fountain Station Record	1902 1 November	One wolf seen at Goose Lake.

Appendix I
Wolf Reports Prior to 1914

Source	Date	Report
Fountain Station Record	3 November	Two wolves seen at north end of Mesa Road on the Gibbon River
	18 November	One wolf seen at 8-mile post between Fountain and Riverside.
Soda Butte Station Record	1904 21 April	Two wolves between Fort Yellowstone and Yancey's.
Sylvan Pass Station Record	1907 3 September	Two wolves seen between Sylvan and Lake.
	4 September	One wolf seen between Lake and Sylvan.
Upper Basin Station Record	1908 10 August	One wolf seen between Upper Basin and Excelsior.
Letter from W. B. Sheppard to Col. L. M. Brett, dated 29 Jan. 1912	1911 Late August	*Gray wolves, of which latter I saw two, and considerable sign . . .*
Letter from Col. L. M. Brett to Wm. J. Hornaday	1912 29 July	*McBride has been in the Park for many years, and is not convinced that there have ever been any gray wolves here. Statements have been made that they have been seen, but none have ever been killed or captured inside of the Park though several were killed on the Upper Gallatin River but a few miles outside in the state of Montana, last spring.*
Nowlin (1912)	1912 25 July	Wolves howling at head of Raven Creek.
Walworth (1971)	1912 December	Tracks of 3-4 wolves seen at Buffalo Ranch (Lamar).
Supt. Annual Report (1912)	1912	*It is claimed that gray wolves have been heard and that their tracks have been seen in the Park, but up to this time none have ever been killed, and there is no absolute proof that they exist within the limits of the reservation, though they have been taken not many miles outside on the cattle ranges in Montana.*
M. P. Skinner (1927)	1912	*In 1912, I saw four [wolves] near Lamar Valley. After that, signs of their presence increased and I believed they were coming in faster.*
Randall (1966)	1913 Spring	Randall saw pack of nine (wolves) along Yellowstone River trail near Hellroaring Creek.

APPENDIX II

Summary of Wolf Reports 1914-26, Yellowstone National Park.

Source	Date	Report
James McBride (1914)	1914 29 January	Tracks of three wolves between Mammoth and 10 miles west.
Lake Station Record	1914 25 April	One wolf seen between Lake and Pelican Creek.
Skinner (1927)	1914 7 September	*. . . When I found an extraordinarily bold pack of eleven big fellows [wolves] in the Pelican Valley.*
Letter of transmittal from F. T. Arnold, Captain 12th Cavalry, to Sec. of Interior	1914 3 December	*Four wolves killed by Ranger Henry Anderson on Slough Creek. Wolves have become rather numerous along the north line of the Park during the past two or three years, and have been seen frequently, but this is the first instance where anyone has been able to capture them or get close enough to shoot them.*
McBride (1914)	1914 21 December	One cow elk killed by wolves between Mammoth and Blacktail Deer Creek.
Letter of transmittal from F. T. Arnold, Captain 12th Calvary, to Sec. of Interior	1914 31 December	*Three more wolves have been killed in the Park during the month making a total of seven killed, and there are indications that they are present in considerable numbers and are destroying much game.*
Supt. Annual Report (1914)	1914	*Gray wolves have made their appearance in the Park in considerable numbers, having been seen traveling in packs of ten or less. While efforts have been made to kill them, thus far none have been taken inside of the Park although a few have been killed just outside, along the northern border . . . efforts will be made to kill them.*
Skinner (1927)	1914-15	*That winter, two or three packs harried the elk on the lower, open valleys of the Park . . . . They began to increase about 1914, soon numbered about sixty . . . .*
Vernon Bailey (1930)	1914 and 1915, Summer	*During the summers of 1914 and 1915 they [wolves] . . . were following the elk herds to the high pastures of Mirror Plateau,*

Appendix II
Wolf Reports 1914-26

Source	Date	Report
Vernon Bailey (1930) - *Cont.*		*returning with them in winter to the valleys along the Lamar and Yellowstone Rivers. In the summer of 1915, Mr. Frazier, at the Buffalo Ranch [Lamar], told me that wolves had been very troublesome during the preceeding winter and had killed many elk. During June of that year, Mr. Frazier killed two half-grown wolf pups and caught two more, which were kept chained up at the ranch. During July and August, 1915, I found where a family of wolves had killed and eaten a young elk in Slough Creek Valley and found wolf tracks along Slough Creek and Lamar Valleys up to the mouth of Mist Creek, also along Pelican Creek, and later a few tracks on Fox Creek at the southern edge of the Park. Tracks were especially numerous along Pelican and Raven Creek where at least ten or a dozen wolves hunted in one pack.*
	1915 July	*On this same trip I found big wolves common, feeding their young on elk, and probably also on buffaloes, as they were right in the midst of the buffalo ranges. This probably accounted for the slow rate of increases of the herd, for after the wolves were trapped out of this section the following winter by Donald Stevenson, the herd began to make rapid increase.*
Bailey (1930)	1915 November	*Donald Stevenson counted nine separate tracks, where a band of wolves had crossed a sandbar on Pelican Creek, but at that time they were leaving that section of the Park and following the elk herds to lower levels.*
	1915	*On Pelican Creek, along the trails which they [wolves] were constantly using, their droppings were made up entirely of elk hair, and a scarcity of elk calves was very noticeable among the herds in that section.*

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Wolf Reports 1914-26

Source	Date	Report
Bailey, Letter to YNP Supt.	1915 13 August	*Band of apparently 8 or 10 large wolves ranging on the upper part of Pelican Creek . . . . There are also some wolves along Slough Creek and some old and young along Lamar River. There seem to be very few elk calves left where these wolves range.*
Tower Station Record	1915 3 September	One wolf seen 9 miles east of Tower.
Cruse Black (1915-16)	1915 10 October	One black wolf seen between Tower Falls and Buffalo Ranch (Lamar).
	16 October	Two-year-old cow elk killed by wolves between Buffalo Ranch (Lamar) and west Lamar Canyon.
Donald Stevenson (1915-16)	1915 19 October	One wolf track between Lake and Pelican Cabin.
Black	1915 23 October	Trapped one female wolf (Rose Creek area).
	24 October	One elk killed by wolves between Buffalo Ranch (Lamar) and Blacktail.
	28 October	Killed one black female wolf up Slough Creek.
	30 October	Killed one black male wolf in Slough Creek.
Stevenson	1915 2 November	Tracks of nine wolves up Pelican Creek from cabin.
	3 November	A few wolf tracks seen in Pelican and Raven Creeks.
Black	1915 3 November	One elk calf killed by wolves between Buffalo Creek and Specimen Ridge.
Stevenson	1915 22 November	One wolf track seen 5 miles down valley from Pelican Cabin.
Black	1915 6 December	One cow elk killed by gray wolves.
Supt. Annual Report (1915)	1915	*Gray wolves are increasing and have become a decided menace to the herds of elk, deer, mountain sheep, and antelope. Several were killed in the Park last winter, and an effort will be made the coming winter to capture or kill them.*
Stevenson	1916 6 January	Saw three wolves in Geode Creek Canyon. Killed one.

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Wolf Reports 1914-26

Source	Date	Report
Black	1916 7 January	Tracks of three wolves between Tower and Buffalo Ranch (Lamar).
	17 January	Wolf tracks on Specimen Ridge. One adult cow elk killed by wolves.
	18 January	Followed tracks of four wolves for 10 miles on Specimen Ridge and found one adult cow elk killed by them.
Tower Station Record	1916 18 January	One wolf seen between Tower and Slough Creek.
Stevenson	1916 20 January	Tracks of two wolves in the Blacktail area.
Black	1916 31 January	One *old* cow elk killed by wolves.
Bailey (1930)	1916 January	*In January, 1916, they [wolves] were found in the Lamar and Yellowstone Valleys, where Stevenson and Black secured four of the old wolves and, later, a family of seven.*
Tower Station Record	1916 13 February	Two wolves seen between Tower and lower Yellowstone River.
Stevenson	1916 14 February	Tracks of two wolves seen in Blacktail area.
	19-20 March	Wolf tracks between Blacktail Cabin and Hellroaring Cabin.
	22 March	Wolf tracks between Hellroaring and Buffalo Ranch (Lamar).
	26 March	Hunted wolf dens. One wolf tracked to den near Hellroaring . . . female seen.
Bailey (1930)	1916 26 March	*One [den] found by Stevenson and Black on the rough slope near Hellroaring Creek on March 26, watched for some days in an effort to shoot the old wolves, which finally became suspicious and carried the pups away to another location farther up the side of the mountain. The den was described as composed of four or five large burrows dug into the open hillside and had evidently been used for several years as a score or more of old elk skulls were lying about, and one fresh elk head that had recently been brought in was found.*

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Source	Date	Report
Stevenson	1916 27 March	One wolf seen near Hellroaring.
	28 March	Two wolves howling near Hellroaring.
	30 March	One large white wolf seen near Hellroaring.
	14 April	Dug out wolf den in the Hellroaring area but they had moved.
	15 April	Found wolf den.
	16 April	One wolf seen and six pups caught.
Bailey (1930)	1916 16 April	*On April 14 [sic], this family of wolves was located about a mile from the first den in a natural cave among some loose rocks. Back about eight feet from the entrance of the cave seven wolf pups estimated to be three weeks old were secured. A freshly killed young elk was found about a half mile from the den and there were pieces of elk meat in the den with the pups. The old wolves were very shy and kept well out of sight while the den was being watched but were frequently heard howling and answering each other from different points and the old male was several times seen guarding the den from a point high above. The male is consistently larger than the female, weighing well over a hundred pounds.*
Stevenson	1916 19 April	Wolf tracks between Tower and Blacktail.
	29 April	Wolf den found near Hellroaring, and one old wolf shot.
	30 April	One pup dug out.
	1 May	Tracks near Hellroaring Creek.
	5 May	Tracks near Yancey's.
	10 May	Den found between Slough Creek Cabin and Hellroaring Cabin.
	12 May	Den found between Yancey's and the Buffalo Ranch (Lamar). One wolf pup dug out.
Supt. Annual Report (1916)	1916	*From October 6, 1916 to June 30, 1916, two United States Biological Survey hunters killed 12 wolves . . . skulls sent to the National Museum. Two young male*

Appendix II
Wolf Reports 1914-26

Source	Date	Report
Supt. Annual Report (1916) - *cont.*		*wolves captured in the spring of 1915 by the employee at the buffalo farm [Lamar] were shipped alive on November 16 to the National Zoological Park.*
Supt. Monthly Report	1917 December	*Wolves not numerous . . . two killed by lion hunter Elkins.*
Supt. Monthly Report	1918 January	*Wolves reported in several different sections of the Park.*
	February	Pack of *about 16* wolves on Specimen Ridge.
	March	Signs of wolves on Specimen Ridge.
	April	Nineteen wolves killed, with indications of *many more* on Specimen Ridge and Hellroaring.
	May	Seven wolves killed. *Towards the end of the month the wolves seemed to leave the Specimen Ridge district and have not been much in evidence since.*
	June	Four wolves killed.
	July	One large gray wolf killed.
	August	Sign of two wolves in the upper Yellowstone area reported by Biological Survey hunter Clemons.
	September	One gray wolf trapped and shot.
	October	Three gray wolves killed.
	November	No wolves killed but *they were considerably in evidence on Slough and Hellroaring Creeks.*
	December	No wolves killed but sign found along north line.
Supt. Annual Report (1918)	1918	Thirty-six wolves killed in the park the year.
Supt. Monthly Report	1919 January	No wolves killed, sign along north line.
	February	Two wolves killed. *Signs indicate presence of several ranging from Mammoth to Soda Butte . . . efforts are being made to exterminate them.*
	November	Reports received of wolves present.
Supt. Annual Report (1919)	1919	Six wolves killed in the park.

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Wolf Reports 1914-26

Source	Date	Report
Supt. Monthly Report	1920 January	Three wolves, including two females, killed.
	March	Nine wolves killed . . . one in the northeast and eight (including seven pups) in Blacktail.
	April	At least 14 wolves killed . . . . one adult in the northeast, eight pups in a den near Tower Falls, five pups in another den near Tower Falls, and one den with pups closed up solid on Blacktail Deer Creek.
	—	
	November	Pack of nine wolves and tracks seen near Tower Falls.
Supt. Annual Report (1920)	1920	Twenty-eight wolves killed by two rangers.
Supt. Monthly Report	1921 January	Forty coyotes and wolves (not distinguished) killed.
	February	Two black wolves seen in Slough Creek and Specimen Ridge.
	March	Several wolf dens located and kept under surveillance.
	April	One den dug out and male (largest ever) and 11 pups destroyed.
	October	One wolf killed by Anderson.
	November	One wolf killed, and many tracks seen in Mammoth and Blacktail Districts.
	December	*A few wolves* identified from signs.
Supt. Annual Report (1922)	1921-22	Twenty-four wolves killed.
Supt. Monthly Report	1922 February	One wolf killed during the winter.
	April	Wolf dens located first week of April between Blacktail and Hellroaring, and adult female killed and 10 pups captured alive. Thirteen (sic) wolves taken to date.
	May	One wolf den discovered on Specimen Ridge, destroyed both adults and six pups. Felt that this was the pair ranging in Lamar Valley for several years --21 (sic) wolves killed to date. *It is evident that the work of controlling these animals must be vigorously*

Appendix II
Wolf Reports 1914-26

Source	Date	Report
Supt. Monthly Report - *Cont.*		*prosecuted by the most effective means available whether or not this meets with the approval of certain game conservationists.*
	July	Three wolves killed.
	August	*Park Ranger Henry Anderson has been hunting out the summer haunts of park wolves and has succeeded in finding what he believes to be their main summer range. This is in a section of the park that is practically inaccessible due to bog holes, rim rock, down timber and jack pines. The area is the part of the Mirror Plateau lying near the head of Timothy, Raven, Pelican and Broad Creeks. Ranger Anderson found numerous signs in this region and due to its inaccessibility and the fact that there is a large amount of game making its summer range near this point, there is no reason why the wolves should not find this area ideal summer home. Anderson will spend the remainder of the month in this locality in an attempt to exterminate as many of these predatory animals as possible.*
	October	Two large wolves, one gray and one black, were killed by Henry Anderson near confluence of Pelican and Raven Creeks (these are the two mounted specimens in the park museum).
Supt. Monthly Report	1923 April	Wolf den near Tower Falls cleared out; old female killed and five pups brought out alive to Mammoth for exhibition.
	December	Wolf signs have been seen near Soda Butte and on Pelican Creek.
Supt. Annual Report (1923)	1923	Eight wolves killed.
Supt. Monthly Report	1924 January	Wolf seen near Bridger Lake on January 15 . . . . *Wolf signs have been very rare this season.*
	February	One wolf seen on Elephant Back near Lake; wolf sign near Mud Geyser.
	March	*Wolf signs have been very scarce throughout the entire season*

Appendix II
Wolf Reports 1914-26

Source	Date	Report
Supt. Monthly Report - *Cont.*		*and we have no report of any wolf kills in the park.*
	April	*Signs of wolf exceedingly scarce . . . .*
	May	*First wolf sign reported during past year observed near Soda Butte . . . also at about the same time at Pelican Creek.*
	September	*There were no reported instances of wolf activity in the park last winter apart from an occasional lone track. None were actually seen in the park. The situation this fall gives promise of a recurrence of the wolf as we have two reports of recent date indicating their presence in the Park. Park Ranger Hall reports having seen three near Heart Lake and a wolf pack numbering twelve are reported to have been seen at Elk Park by two members of a road crew on duty near that point. This last report has not been definitely confirmed and may be exaggerated.*
	November	A number of wolf signs were observed in October but only one track has been reported for November.
	December	Two wolf signs seen on December 16 on south slope of Saddle Mountain.
Supt. Monthly Report	1925 October	Three wolf signs were observed on the east shore of Yellowstone Lake on the 20th.
Supt. Monthly Report	1926 January	*One wolf sign recently seen on Cabin Creek.*
	October	*There is believed to be a very limited number of wolves in the Park.*
	December	Sign of one, perhaps two. wolves along lower trail between Hellroaring and Tower Falls.
Bailey (1930)	1926	Tracks on Two Ocean Pass and one wolf seen on Trident Plateau by Sierra Club party.

APPENDIX III

Summary of Wolf Reports, 1927-36, Yellowstone National Park.

Source	Date	Report
Supt. Monthly Report	1927 February	*Wolf signs have been rarely seen in the Park this winter and we have every reason to consider that there are only a very few in the entire park area.*
	October	*It is doubtful if there are more than a very few wolves in the entire park area.*
	November	*Ranger Ogston reports signs of two wolves in the vicinity of the Slough Creek mailbox.*
Supt. Monthly Report	1928 February	*Wolf signs have been rarely observed.*
	October	*There have been no wolf sign reported this season.*
Supt. Monthly Report	1929 September	*Wood crews at Yellowstone Lake reported seeing two gray wolves.*
Supt. Monthly Report	1930 January	*A wolf has been reported working in the Tower Falls and Hellroaring districts. The tracks have been seen many times, and two elk calves have been found that were from all evidence, killed by this wolf.*
Arnold (1937)	1934 winter	Four wolves seen up Tower Creek.
Supt. Monthly Report	1936 April	*Five wolves were seen and reported in the vicinity of Old Faithful. Several freshly killed elk carcasses found in this vicinity suggest that the animals seen were actually wolves instead of coyotes.*

National Park Service

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